

A LAND POLLUTION ASSESSMENT OF  
GRANITE CITY/TARACORP INDUSTRIES

September, 1984

- DRAFT -

Illinois Environmental Protection Agency  
Division of Land Pollution Control  
2200 Churchill Road  
Springfield, Illinois 62706

## TABLE OF CONTENTS

	<u>Page</u>
List of Tables.....	ii
List of Figures.....	iii
Introduction.....	1
Location.....	2
Geology of the Granite City Area.....	2
Groundwater Conditions in the American Bottoms.....	3
Water Table Flucuations.....	8
Methods of Investigation.....	11
Chemical Analyses of Groundwater Samples.....	12
Chemical Analyses of Soil Samples.....	16
Discussion of the Results of the Soil Samples.....	18
Conclusions and Recommendation.....	19
References.....	21
Appendix A: Chemical Analyses of Water Samples	
Appendix B: Boring Logs	
Appendix C: Monitor Well Construction Data	

## LIST OF TABLES

	<u>Page</u>
Table 1 -- Water Elevations of Monitoring Wells.....	10
Table 2 -- General Use Water Quality Standards.....	13
Table 3 -- Chemical Analysis of Soil Samples.....	17

## LIST OF FIGURES

	<u>Page</u>
Figure 1 -- Location of the East St. Louis Area.....	4
Figure 2 -- Monitor Well Locations.....	5
Figure 3 -- Thickness of the Valley Fill.....	6
Figure 4 -- Bedrock Topography.....	6
Figure 5 -- Geologic Cross Section and Piezometric Profile of the Valley Fill.....	6
Figure 6 -- Geologic Cross Section from Borings at Taracorp.....	7

## Introduction

In 1981 the Division of Air Pollution of the Illinois Environmental Protection Agency (IEPA), was alerted to the increase in airborne lead in the Granite City area. Information from air pollution monitors and meteorological data indicated the source of the airborne lead was in the direction of a secondary lead smelter (Taracorp Industries) and an adjacent recycling industry (St. Louis Lead Recyclers). It was this increase in airborne lead which brought about a more comprehensive investigation into the lead contamination in this area. One portion of the investigation was to determine if the three-acre storage pile of broken batteries, blast furnace slag and other lead waste products was causing any contamination to the soils or groundwater.

The initial groundwater study began in October of 1982 when Taracorp, at the request of the Agency, installed four monitoring wells (G101-G104). Chemical analysis of soil samples at Boring 1 (G101) showed a significantly high concentration of lead at the 14-15.5 foot depth.

Boring 1 (G101)	<u>Sample Depth</u>	<u>Lead Present in ppm*</u>
(data in feet below ground surface)	4 - 5.5 ft.	43.0
	9 - 10.5 ft.	51.0
	14 - 15.5 ft.	2700.0
	19 - 20.5 ft.	43.0
	24 - 25.5 ft.	14.0
	29 - 30.5 ft.	13.0

\*Lead levels were analyzed in the laboratory by an acid digest test, which indicates total lead present in the soil samples.

Groundwater samples taken on November 16, 1982, also indicated elevated lead levels of 0.05 ppm from the downgradient monitor well G104. The information indicated a need for more soil and groundwater sampling. (The integrity of these samples were later questioned because the samples were not field filtered and were discarded as invalid.) In July of 1983, the IEPA's drill rig team installed eight additional borings, the data of which, is the bulk of this report.

#### Location

Granite city is located in the southwestern portion of Madison County. It lies in the broad valley of the Mississippi River known as the American Bottoms (figure 1). The focus of this investigation was on and around the property of Taracorp Industries in Granite City (figure 2).

#### Geology of the Granite City Area

Granite City lies in the Mississippi Flood Plain known as the American Bottoms. Unconsolidated sediments of the valley consists of a poorly sorted, silty river lain deposit called alluvium. Thickness varies but can range from absent, where the river has been actively eroding, to 75 feet thick. Below this lies voluminous deposits of sediments deposited by meltwaters from the glaciers during the Pleistocene Epoch. These sediments, called valley train deposits, consist mostly of well sorted sands and gravels. The total thickness of the unconsolidated sediment at Granite City is between 100 and 120 feet thick (figure 3).

Underlying these unconsolidated deposits lies the bedrock surface consisting of Mississippian and Pennsylvanian Age rocks (figure 4). The width of the Mississippi Flood plain at the American Bottoms is due in part to the ease in erodability of the Pennsylvanian Age bedrock, which is currently found in the eastern portion of the Bottoms. Up and downstream of the American Bottoms the River crosses over the more resistant limestone that occurs in the present day Mississippi River channel at an area known as Chain of Rocks.

The sediment encountered while drilling was alluvium consisting of poorly sorted, fine grain sands with some clay stringers throughout. In general, grain sizes increased with depth (see figure 6 and Appendix b). Man made deposits, noted as fill material, were also found at three of the four boring locations ranging in thickness from one to six feet.

#### Groundwater Conditions in the American Bottoms

The major aquifer of this area includes both the alluvium and the glacial outwash. It was this prolific water supply that provided the area with a valuable resource for growth and expansion. Water could be cheaply obtained and was of better quality than water from the deeper bedrock aquifer.

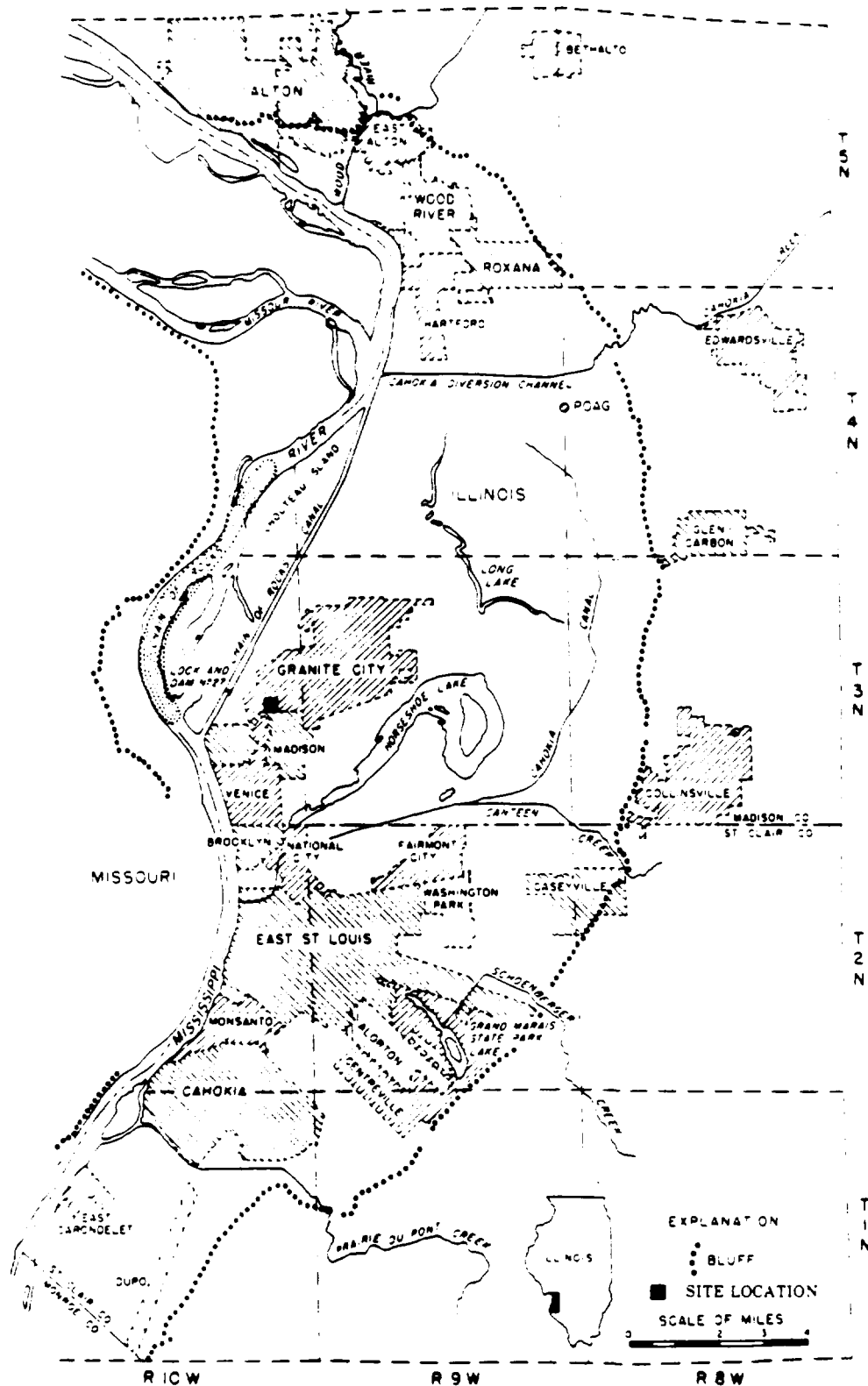
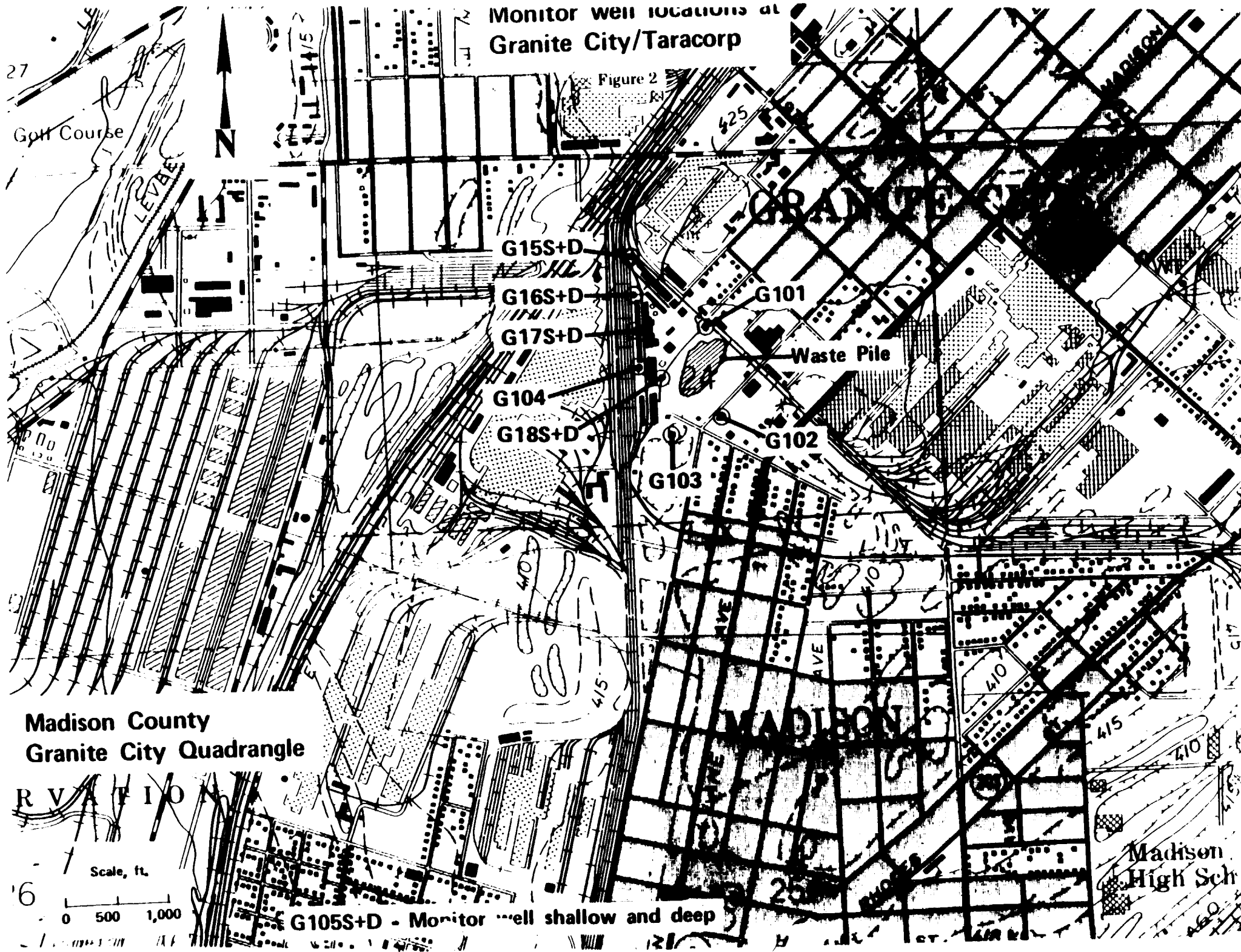


Figure 1. Location of the East St. Louis area

Dotted line indicates the boundary of the American Bottoms  
(Taken from Emmons, ISWS, circular 134, fig. 1, p.2, 1979).





Monitor well locations at  
Granite City/Taracorp

Figure 2

G15S+D

G16S+D

G17S+D

G104

G18S+D

G101

Waste Pile

G102

G103

Madison County  
Granite City Quadrangle

Scale, ft.

0 500 1,000

G105S+D - Monitor well shallow and deep

Madison  
High Sch

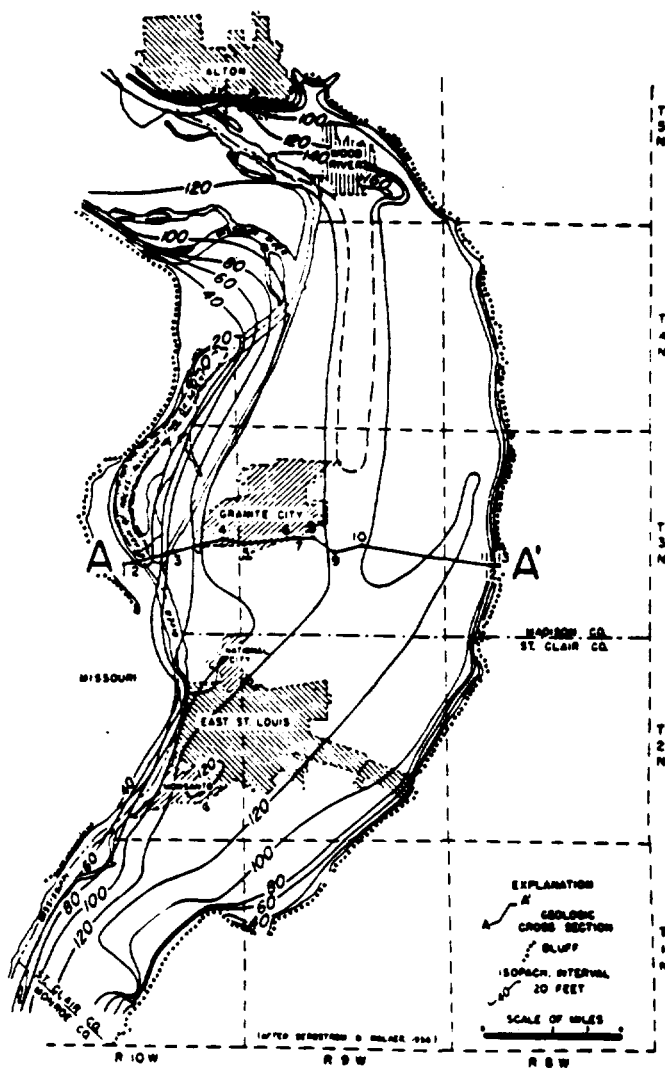


Figure 3 Thickness of the valley fill

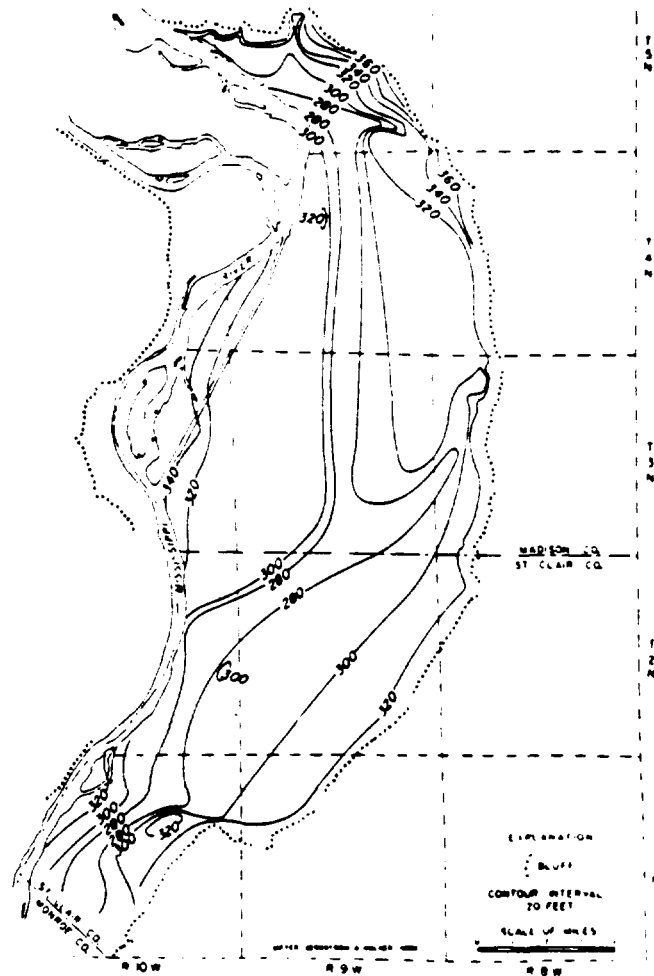


Figure 4. Bedrock topography

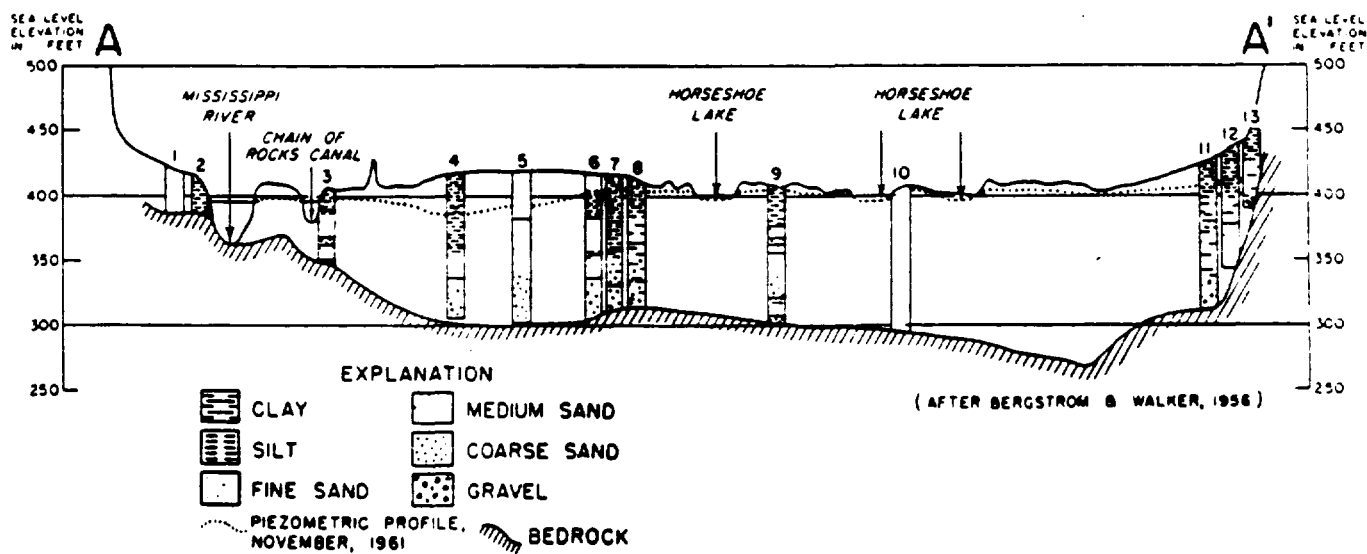


Figure 5 Geologic cross section and piezometric profile of the valley fill

N

Figure 6

MADISON COUNTY  
Granite City/Taracorp  
L11904007

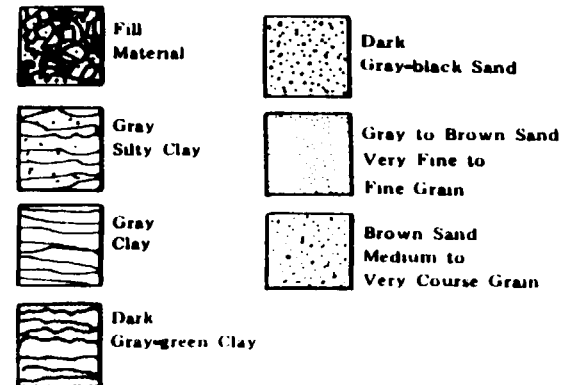
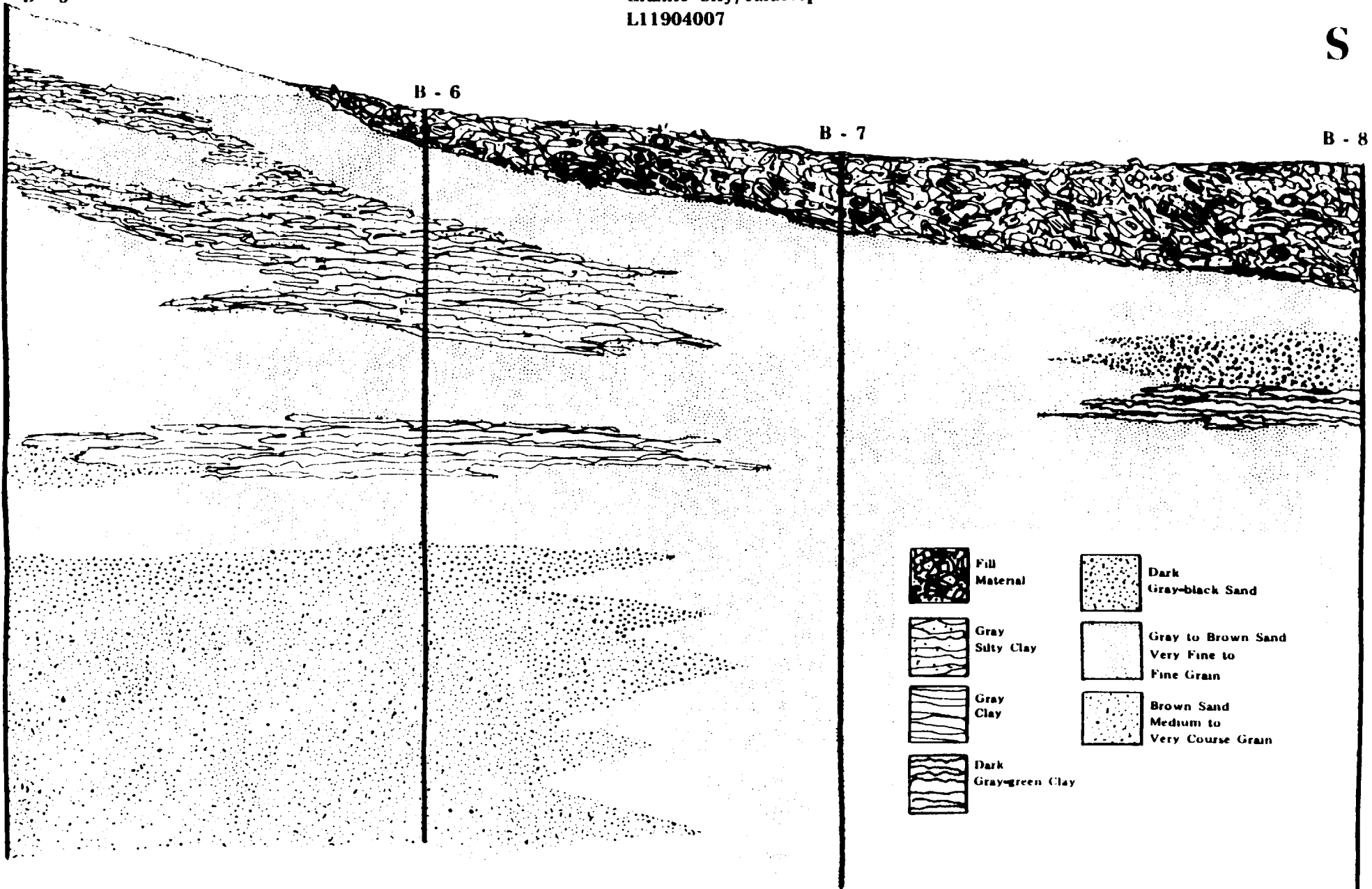
B - 5

B - 6

B - 7

S

B - 8



The groundwater occurs in this area under watertable and leaky artesian conditions. Leaky artesian conditions are most common and exist due to the low permeable fine grained alluvium over the more permeable coarse grained valley-train deposits. The groundwater in the lower coarser valley-train deposits is not totally confined by the alluvium, hence the name leaky artesian. Water-table conditions occur when; the alluvium is missing, or the top of the zone of saturation is in the valley-train deposits, or the water is unconfined due to pumping and the occurrence of a deep cone of depression. ← *condition*

Recharge of this aquifer is mainly from rainfall seepage and percolation from the Mississippi River and its tributaries traversing the Bottoms. There is very little runoff due to the low relief in this area and most of the rainfall will either seep into the ground or evaporate.

#### Water Table Fluctuations

Prior to the settlement and industrialization of the East St. Louis Area, the water table was very near the surface. The water table would fluctuate in response to various changes in rainfall and river levels, and would frequently be highest in May and the lowest in December. Because of poor drainage and recurrent flooding, levies and drainage ditches were built to help dewater the area for development.

With the onset of rapid industrialization at the turn of the century, pumpage of the shallow aquifer began to increase. From 1900 to 1956

groundwater pumpage rose from 2.1 million gallons per day (mgd) to 111.0 mgd. The increase pumpage plus the drought between 1952-1956 caused water levels around the major industrial areas to drop drastically. This was especially true in the Granite City Area when in 1956 water levels dropped to an all time low of 345 feet above mean sea level (msl). This was a difference of 55 feet from the previous recorded elevations of 400 feet (msl). Granite City Steel, which was the major groundwater user in this area, abandoned its well in 1957 and began obtaining water from the Mississippi River. As a result of this pumpage reduction, the water table began to rise.

	<u>1956</u>	<u>1960</u>	<u>1961</u>	<u>1962</u>	<u>1971</u>	<u>1977</u>
Total pumpage (mgd) for the Granite City Area	30.1	7.9	8.8	9.5	6.9	8.8

Current water levels from monitor wells installed by the Agency in the vicinity of Taracorp, showed levels back up to the previous recorded elevations of 400 feet (msl) (Table 1).

The general flow of the groundwater is toward the Mississippi River. However, pumpage of the shallow aquifer has reversed the flow in many areas causing the water to flow toward the pumping wells. Present water level data at Taracorp shows movement toward the west and south.

Water Elevations of Monitoring Wells  
at Granite City/Taracorp

Monitor Point	Surface Elevation	Top of Casing (TOC)	TOC Elevation	<u>Dates Water Levels Collected</u>						
				11-16-82	1-26-83	2-28-83	6-29-83	8-1-83	8-24-83	10-11-83
G101	418.9	3.0	421.9 M	399.3	402.8	402.9	404.2	--	402.7	401.9
G102	414.0	3.3	417.3 M	399.2	401.7	401.6	402.2	--	399.7	398.7
G103	414.6	3.0	417.6 M	398.8	402.15	401.9	402.7	--	400.4	399.2
G104	417.8	3.0	420.8 M	397.7	400.5	400.6	401.7	--	400.1	399.0
G15S	425.94	2.93	428.87 P					402.07	401.29	399.97
G15D	426.05	2.94	428.99 P					402.09	401.30	399.89
G16S	421.12	2.88	424.00 P					402.00	Dry	Dry
G16D	421.10	2.83	423.93 P					402.03	401.15	399.83
G17S	419.06	2.01	421.07 P					404.77	404.58	403.27
G17D	419.07	2.90	421.97 P					402.97	400.99	399.67
G18S	419.94	2.94	422.88 P					402.08	401.10	399.98
G18D	420.00	1.88	421.88 P					401.58	400.63	399.28

M = Metal pipe

P = PVC pipe

SO:tk/38

TABLE 1

### Methods of Investigation

In July of 1983, eight monitor wells were installed by the IEPA's drilling team. The entire study was done using a CME 55 drill rig with a 3 1/4 inch inside diameter hollow stem auger. Within the auger either a primary or secondary sampling device was used to retrieve a continuous soil sample for geologic interpretation and chemical analysis. The primary sampler is the CME five foot continuous sampler consisting of a 3 inch diameter split tube with a tapered cutting head. This sampler retrieves a 2 1/4 inch diameter nearly undisturbed continuous sample and is indicated on the boring logs by the initials CS. The Standard Lunac Split Spoon was the secondary sampler used. This sampler is a 2 inch diameter split tube that retrieves a 1 3/8 inch disturbed soil sample up to 18 inches long. Samples were obtained in accordance with ASTM Standards D-1586 and is indicated on the boring logs by the initials SS.

Soil samples were removed from the sampler at the site and split length-wise. A visual description of the soil was made and a composite sample was taken from the center of the core and placed in an 8 oz. glass jar for chemical analysis. Sampling intervals are indicated on the logs by S<sub>1</sub>, S<sub>2</sub> etc.

Four sets of monitor wells with two wells per set were installed at four locations on Taracorp Industries' property (figure 2). At each location a shallow well was installed at the water table which is indicated by the letter S after the well number on the boring log and the monitor

well construction sheet. Three to five feet from the shallow well a second well was installed. This well was drilled to a depth 10-15 feet deeper than the shallow well and is indicated on the boring logs and monitor well construction sheets by the letter D after the well number.

#### Chemical Analysis of Groundwater Samples

The chemical analyses of groundwater samples collected from monitor wells at Taracorp were compared to the Illinois General Use Water Quality Standards (35 Ill. Adm. Code 302.208), (see table 2). Monitor wells G101 through G104 were sampled in January, February, June, August, and November of 1983. Wells G15<sup>S</sup> through G18D were installed in July of 1983 with samples taken in August and November only. (See Appendix A for water analysis data.) Constituents which averaged consistently above the Water Quality Standards were: iron, manganese, and residue on evaporation (ROE) in G101; boron and ROE in G102; manganese, ROE, and sulfate in G17S; iron and ROE in G17D; and cadmium, chloride, fluoride, iron, manganese, nickel, ROE, silver, sulfate, and zinc in G18D. Averages could not be determined for G15S, G18S and G16S due to lack of sufficient water in the monitor wells. All other wells showed no significant averages above the Water Quality Standards or only one sample was over the Standards and, therefore, could not be averaged.

A comparison of the monitor wells showed groundwater samples from G101 ten times higher in arsenic. The concentrations, however, were not above the Standard of 1.0 mg/l of arsenic. Iron and manganese



General Use Water Quality Standards  
(35 Illinois Administrative Code 302.208)

<u>Constituent</u>	<u>Concentration in mg/l</u>
Arsenic (total)	1.0
Boron (total)	1.0
Cadmium (total)	0.05
Chloride	500.0
Chromium (total)	1.0
Copper (total)	0.02
Fluoride	1.4
Iron (total)	1.0
Lead (total)	.1
Manganese (total)	1.0
Nickel (total)	1.0
Residue on Evaporation	1000.0
Silver (total)	0.005
Sulfate	500.0
Zinc	1.0

SO:mks:16/47

TABLE 2

were also significantly higher in monitor well G101. The greater concentrations of arsenic, manganese, and iron in this well could be due to it's location near the waste pile.

Groundwater samples containing high amounts of boron, iron, manganese, ROE, and sulfate were somewhat expected due to the sites location in an old highly industrial area. However, these constituents are of low toxicity and are not considered hazardous at these levels.

Of most concern is the very high cadmium levels in G18D and G18S. Water samples collected from G18D on 8/24/83 and 10/11/83 showed cadmium levels of 17.0 ppm and 13.0 ppm respectively and 0.12 ppm from G18S on 8/24/83. The very high levels of cadmium in the groundwater could be the result of the wells location to the waste pile and the battery breaking operations which allowed some of the acid from the batteries to seep into the ground. The acid would lower the pH causing the release of various metals, such as cadmium, that are in the soil. These metals could then be leached into the groundwater.

A study by the Oak Ridge National Laboratory on the effects of cadmium found background levels are normally low (0.4 ppm and less for soils and less than 1.0 ppb for open rural waters). The highest levels of cadmium were found in areas of heavy industry with soil concentrations between 10-100 ppm and surface waters between 1-100 ppb.

Cadmium is a major environmental concern because it is a cumulative poison. Levels of cadmium increase in the body with age and build up mainly in the liver and kidneys. In the soil, cadmium is taken up by food chain crops which directly increases the dietary cadmium levels in animals and humans. Levels as low as 2-5 ppm in the diet are harmful to animals. Further testing of soils and gardens in the area should confirm if there is any problem.

High nickel levels were reported for well G18D. This is a good indicator of the site's contamination to the groundwater. In most groundwaters, nickel has not been identified. So when it is present it is most likely due to industrial pollution. Water samples collected from G18D on 8/24/83 and 10/11/83 showed levels of 2.5 ppm and 1.6 <sup>ppm</sup> pp, respectively. In the United States the average concentration of nickel in public water supplies is 4.8 ppb. Nickel has relatively low toxicity and there is no evidence that it is carcinogenic in animals from oral or cutaneous exposure.

The groundwater contamination that occurs at wells G18S and G18D does not appear, at this time, to have migrated from Taracorp's property. Evidence of this is indicated by the chemical analysis of water samples from monitor wells G101 through G17D. Neither cadmium or nickel was detected in any of the water samples tested from these wells. Metal levels should be monitored closely in the future to insure that the contamination is not leaving the site and all monitor wells should continue to be monitored for arsenic, boron, cadmium, chloride, iron, lead, manganese, nickel, ROE, sulfate and zinc.

Chemical Analysis<sup>e</sup> of Soil Samples

Soil samples taken from borings drilled at this site were tested for five metals; arsenic, antimony, lead, zinc, and magnesium. (see table 3). The samples were analyzed by an acid digest test which indicates the total metal content of a soil. This does not indicate the amount of free or soluble metal present which is used in determining the metals mobility through the soil or toxicity to plants and animals.

Since there are no formal standards for the allowable concentrations of metals in soils, common ranges and means were used to identify above normal levels.

Common Metal Ranges and Means for Soils

<u>Element</u>	<u>Common Range for soils in ppm</u>	<u>Common Mean for soils in ppm</u>
Arsenic	1.0 - 50.0	5.0
Antimony	1.0 - 200.0	No Data
Lead	2.0 - 200.0	10.0
Magnesium	600.0 - 6,000.0	5,000.0
Zinc	10.0 - 300.0	50.0

Soil chemistry varies due to differences in climate, vegetation, topography, the geologic parent material, and the geographic location (agricultural vs. industrial). It is for this reason that the common ranges for metals in soils has such a wide variation of concentrations.

Chemical Analysis of Soil Samples for Granite City/Taracorp

Boring No.	Sample No./depth in feet	analysis in p.p.m.				
		Arsenic As	Antimony Sb	Lead Pb	Zinc Zn	Magnesium Mg
B-5	S- 1/ 2.5- 4.0	10	4.0	520	92	2700
	S- 3/ 5.5- 7.0	6.4	1.0	96	50	1900
	S- 5/ 8.5-10.0	7.1	1	60	53	5500
	S- 7/11.5-13.0	4.6	1	13	39	5500
	S- 9/14.5-16.0	2.6	1	9	30	4000
	S-11/17.5-19.0	2.5	1	11	29	3600
	S-13/20.5-22.0	1.7	1	18	22	1600
	S-15/23.5-25.0	2.8	1	10	29	2300
B-6	S- 1/ 0.0- 5.0	6.1	13.0	290	2200	1200
	S- 3/ 7.5-10.0	8.0	1.0	27	120	6500
	S- 5/11.5-13.0	5.6	1	22	120	6000
	S- 7/14.5-16.0	11.0	2	510	100	7000
	S- 9/17.5-19.0	2.5	1	14	38	5000
	S-11/20.0-22.0	2.1	1	67	29	2600
	S-13/24.5-27.0	1.5	1	8	23	1500
	S-15/30.0-33.0	1.3	1	7	20	1300
B-7	S- 1/ 3.5- 5.0	150	20	15	580	1700
	S- 3/ 7.2- 8.7	80	20	25	65	6000
	S- 5/10.0-11.5	8.6	1	22	65	7500
	S- 7/14.5-16.0	8.6	2	230	58	7000
	S- 9/17.5-19.0	3.2	1	37	50	5500
	S-11/20.5-22.0	3.4	1	33	41	5500
	S-13/30.0-33.8	6.0	1	22	67	6500
B-8	S- 1/ 2.5- 5.0	40	5	150	27	7500
	S- 2/ 5.0- 6.4	30	2	70	37	1300
	S- 3/ 6.4-10.0	8	1	15	74	1400
	S- 4/10.0-10.8	12	3	120	39	350
	S- 5/10.8-11.5	7.9	1	110	120	3000
	S- 6/11.5-13.0	6.6	1	22	140	2500
	S- 7/13.0-14.5	5.6	1	21	140	1600
	S- 8/14.5-16.0	6.4	1	15	100	1400
	S- 9/16.0-17.5	6.1	1	18	100	1500
	S-10/17.5-19.0	2.8	1	11	29	1100
	S-11/19.0-20.5	2.7	1	10	26	950
	S-12/20.5-22.0	2.7	1	14	27	1000
	S-13/20.0-25.0	5.3	1	63	82	1500
	S-14/25.0-27.5	3.8	1	23	250	2900
	S-15/27.5-30	3.2	1	18	33	3000
	S-16/30.0-32.5	4.4	1	33	58	3800
	S-17/32.5-35	5.1	1	48	71	4000

Discussion of the Results of the Soil Samples

Arsenic -- Thirty-eight out of forty soil samples tested fell within the common range for arsenic of 1.0 to 50.0 ppm. The two samples that were above the normal range were from boring number B-7 from 3.5 to 5.0 and 7.2 to 8.7 foot depth with concentrations of 150 ppm and 80 ppm respectively.

The common mean concentration for arsenic in soils is 5.0 ppm. 57.5% of the samples tested were above this common mean.

Antimony -- All soil samples tested at this site fell within the common range of 1.0 to 200.0 ppm.

No data was available for the common mean concentration of antimony in soils. However, the average concentrations of the soils analyzed for antimony at this site were 2.6 ppm. Six of the forty samples analyzed were above this average.

Lead -- Thirty-seven out of forty soil samples tested fell within the common range for lead of 2.0 to 200.0 ppm. The three samples that were above the common range were from; boring number B-5 from 2.5 to 4.0 foot depth with 520 ppm, boring number B-6 from 14.5 to 16.0 foot depth with 510 ppm, and boring number B-7 from 14.5 to 16.0 foot depth with 230 ppm.

The common mean concentration for lead in soils is 10.0 ppm. 87.5% of the samples tested were above this common mean.

Magnesium -- Thirty-six out of forty soil samples tested fell within the common range for magnesium of 600.0 to 6,000.0 ppm. The four samples that were above the common range were from; boring number B-6 from 14.5 to 16.0 foot depth with 7,000 ppm, boring number B-7 from 10.0 to 11.5 and 14.5 to 16.0 foot depth with 7,500 ppm and 7,000 ppm respectively, and boring number B-8 from 2.5 to 5.0 foot depth with 7,500 ppm.

The common mean concentration for magnesium in soils is 5,000.0 ppm. 3.0% of the samples tested were above this common mean.

Zinc -- Thirty-eight of the forty soil samples tested fell within the common range for zinc of 10.0 to 300.0 ppm. The two samples that were above the common range were from; boring number B-6 from 0.0 to 5.0 foot depth with 2,200 ppm, and boring number B-7 from 3.5 to 5.0 foot depth with 580 ppm.

The common mean concentrations for zinc in soils is 50.0 ppm. 52.5% of the samples tested were above this common mean.

#### Conclusions and Recommendations

1. Groundwater samples from monitor wells G185 and G18D show groundwater contamination from the secondary lead smelter, in particular, the battery breaking operations. However, all other monitor wells indicate that contamination has not migrated beyond Taracorp's property.

2. Very high concentrations of cadmium (as high as 17.0 ppm) were found in groundwater samples taken from monitor wells ~~G105 and~~ G18D.
3. The high concentrations of cadmium found in the groundwater was probably leached from the soils in this area. This leads to the possibility of high cadmium concentrations in the soil. In soils cadmium is readily taken up by plants and would directly increase the dietary cadmium levels in animals and humans. Levels as low as 2-5 ppm in the diet can be harmful.
4. Soil samples from the borings drilled at Taracorp were analyzed for total arsenic, antimony, lead, ~~ma~~magnesium and zinc. 200 chemical analyses were conducted. 94.5% of the samples fell within the common ranges for each of these elements. The percent of soil samples above the common mean concentrations were 57.5% for arsenic, 87.5% for lead, 3.0% for magnesium, and 52.5% for zinc.
5. All monitor wells should continue to be monitored for arsenic, boron, cadmium, chloride, iron, lead, manganese, nickel, residue on evaporation (ROE), sulfate, and zinc. Also pH measurements should be taken of the water samples at the time the samples are collected.
6. Surface soils (the top two feet) and garden plants in the residential areas near Taracorp should be analyzed for cadmium.



## References

- Baker, W. H. Jr., 1972. Groundwater Levels and Pumpage in the East St. Louis Area, Illinois, 1967-1971. Illinois State Water Survey Circular 112.
- Bergstrom, R.E. and Walker, T. R., 1956. Groundwater Geology of the East St. Louis Area, Illinois. Illinois State Geological Survey Report of Investigation 191.
- Bruin, Jack and Smith, H. F., 1953. Preliminary Investigation of Groundwater Resources in the American Bottoms in Madison and St. Clair Counties, Illinois. Illinois State Water Survey Report of Investigation 17.
- Committee on Medical and Biologic Effects of Environmental Pollutants, 1977. Arsenic: Medical and Biological Effects of Environmental Pollutants. National Research Council, National Academy of Sciences. Natl. Acad. Pr.
- Committee on Medical and Biologic Effects of Environmental Pollutants, 1979. Iron: Medical and Biological Effects of Environmental Pollutants. National Research Council, National Academy of Sciences. Natl. Acad. Pr.
- Committee on Medical and Biologic Effects of Environmental Pollutants, 1973. Manganese: Medical and Biological Effects of Environmental Pollutants. National Research Council, National Academy of Sciences. Natl. Acad. Pr.
- Committee on Medical and Biologic Effects of Environmental Pollutants, 1975. Nickel: Medical and Biological Effects of Environmental Pollutants. National Research Council, National Academy of Sciences, Natl. Acad. Pr.
- Emmons, J. T., 1979. Groundwater Levels and Pumpage in the East St. Louis Area, Illinois 1972-1977. Illinois State Water Survey Circular 134.
- Gibb, J. P. and Cartwright, Keros, 1982. Retention of Zinc, Cadmium, Copper and Lead by Geologic Materials. Illinois State Water Survey and Illinois State Geological Survey Cooperative Groundwater Report 9.
- Griffin, R. A. and Shimp, N. F., Effects of pH on Exchange-Adsorption or Precipitation of Lead from Landfill Leachates by Clay Minerals: re-printed from Environmental Science and Technology, Vol. 10, Dec. 1976, page 1256.
- I.E.P.A. file. Madison County, Granite City/Taracorp, L11904007.

~~Page 2.~~

Illinois Environmental Protection Agency, Study of Lead Pollution in Granite City, Madison and Venice, Illinois, April 1983.

Lindsay, W. L., 1979. Chemical Equilibria in Soils. John Wiley and Sons, Inc.

Oak Ridge National Lab, Tenn., June 1978. Reviews of the Environmental Effects of Pollutants: IV. Cadmium. prepared for the Department of Energy. PB-283-085.

Overcash, M. R. and Pal, Dhiraj, 1979. Design of Land Treatment Systems for Industrial Wastes - Theory and Practice. Ann Arbor Science Publishers, Inc.

Schicht, R. J., 1965. Ground-Water Development in East St. Louis Area, Illinois. Illinois State Water Survey Report of Investigation 51.

Walton, W. C., 1965. Ground-Water Recharge and Runoff in Illinois. Illinois State Water Survey Report of Investigation 48.

SMO:tk/4

Appendix A  
Chemical Analysis of Water Samples

Parameters	Dates Samples Collected				
	1-26-83	2-28-83	6-29-83	8-24-83	10-11-83
Arsenic	0.053	0.09	0.07	0.071	0.070
Boron	0.7	0.7	0.7	0.8	0.8
Cadmium	0.00	0.00	0.00	0.00	0.00
Chloride	58.0	66.0	61.0	59.0	66.0
Chromium (total)	0.00	0.00	0.00	0.00	0.00
Copper	0.00	0.01	0.0	0.0	0.0
Fluoride	0.7	0.6	0.7	0.7	0.6
Iron	53.0	53.0	0.7	4.9	49.0
Lead	0.0	0.0	0.0	0.0	0.05
Manganese	8.80	0.0	9.2	8.6	7.6
Nickel	0.0	0.0	0.0	0.0	0.0
Residue on Evaporation	1,208.0	*	1,358.0	1,114.0	1,097.0
Silver	0.01	0.02	0.0	0.02	0.00
Sulfate	431.0	439.0	535.0	420.0	390.0
Zinc	0.1	0.2	0.1	0.0	0.0

\* Sample discarded before analysis.

Chemical Analysis of Water Samples in ppm for Monitor Well G101.

Parameters	Dates Samples Collected				
	1-26-83	2-28-83	6-29-83	8-24-83	10-11-83
Arsenic	0.005	0.006	0.004	0.002	0.001
Boron	1.1	1.2	1.2	1.6	1.6
Cadmium	*	0.00	0.0	0.00	0.00
Chloride	39.0	28.0	29.0	33.0	31.0
Chromium (total)	0.0	0.00	0.0	0.00	0.00
Copper	0.0	0.00	0.0	0.0	0.0
Fluoride	0.1	0.1	0.2	0.2	0.2
Iron	2.8	0.7	0.2	0.8	0.2
Lead	0.0	0.0	0.0	0.0	0.05
Manganese	1.9	0.0	0.23	0.76	1.06
Nickel	0.0	0.0	0.0	0.0	0.0
Residue on Evaporation	894.0	*	1,071.0	1,130.0	1,156.0
Silver	0.00	0.01	0.0	0.01	0.00
Sulfate	224.0	310.0	375.0	445.0	500.0
Zinc	0.1	0.1	0.1	0.0	0.0

\* Not sampled.

Chemical Analysis of Water Samples in ppm for Monitor Well G102.

Parameters	Dates Samples Collected				
	1-26-83	2-28-83	6-29-83	8-24-83	10-11-83
Arsenic	0.001	0.001	0.001	0.001	0.001
Boron	0.2	0.8	0.6	0.6	0.6
Cadmium	0.00	0.00	0.0	0.00	0.00
Chloride	14.0	13.0	7.0	6.0	8.0
Chromium (total)	0.00	0.00	0.0	0.00	0.0
Copper	0.00	0.00	0.0	0.0	0.0
Fluoride	0.2	0.1	0.1	0.2	0.2
Iron	0.1	0.0	0.0	0.1	0.0
Lead	0.0	0.0	0.0	0.0	0.05
Manganese	0.53	0.0	0.10	0.02	0.02
Nickel	0.0	0.0	0.0	0.0	0.0
Residue on Evaporation	917.0	*	837.0	652.0	677.0
Silver	0.00	0.00	0.0	0.00	0.00
Sulfate	313.0	415.0	340.0	290.0	290.0
Zinc	0.0	0.1	0.2	0.0	0.0

\*Sample discarded before analysis.

Chemical Analysis of Water Samples in ppm for Monitor Well G103.

Parameters	Dates Samples Collected				
	1-26-83	2-28-83	6-29-83	8-24-83	10-11-83
Arsenic	0.001	0.002	0.003	0.004	0.002
Boron	0.1	0.5	0.3	0.3	0.2
Cadmium	0.0	*	0.0	0.0	0.0
Chloride	86.0	68.0	52.0	24.0	27.0
Chromium (total)	0.0	0.0	0.0	0.0	0.0
Copper	0.0	0.0	0.0	0.0	0.0
Fluoride	0.1	0.2	0.1	0.2	0.1
Iron	0.1	0.0	0.0	0.0	0.0
Lead	0.0	0.0	0.0	0.0	0.05
Manganese	2.1	0.0	0.10	0.05	0.02
Nickel	0.0	0.0	0.0	0.0	0.0
Residue on Evaporation	1,072.0	*	459.0	311.0	361.0
Silver	0.00	0.00	0.0	0.00	0.00
Sulfate	347.0	155.0	134.0	100.0	123.0
Zinc	0.1	0.1	0.1	0.1	0.0

\*Sample discarded before analysis.

Chemical Analysis of Water Samples in ppm for Monitor Well G104.

Parameters	Dates Samples Collected				
	1-26-83	2-28-83	6-29-83	8-24-83	10-11-83
Arsenic	--	--	--	0.000	dry
Boron	--	--	--	1.4	dry
Cadmium	--	--	--	0.00	dry
Chloride	--	--	--	36.0	dry
Chromium (total)	--	--	--	0.00	dry
Copper	--	--	--	0.0	dry
Fluoride	--	--	--	0.3	--
Iron	--	--	--	0.1	dry
Lead	--	--	--	0.0	dry
Manganese	--	--	--	0.18	dry
Nickel	--	--	--	0.0	--
Residue on Evaporation	--	--	--	929.0	dry
Silver	--	--	--	0.00	--
Sulfate	--	--	--	280.0	dry
Zinc	--	--	--	0.0	--

Chemical Analysis of Water Samples in ppm for Monitor Well G15S.



Parameters	Dates Samples Collected				
	1-26-83	2-28-83	6-29-83	8-24-83	10-11-83
Arsenic	--	--	--	0.000	0.001
Boron	--	--	--	0.9	1.0
Cadmium	--	--	--	0.0	0.03
Chloride	--	--	--	31.0	40.0
Chromium (total)	--	--	--	0.0	0.0
Copper	--	--	--	0.0	0.03
Fluoride	--	--	--	0.5	0.5
Iron	--	--	--	0.0	0.0
Lead	--	--	--	0.0	0.05
Manganese	--	--	--	0.17	0.23
Nickel	--	--	--	0.0	0.0
Residue on Evaporation	--	--	--	715.0	661.0
Silver	--	--	--	0.00	0.00
Sulfate	--	--	--	172.0	158.0
Zinc	--	--	--	0.1	0.0

Chemical Analysis of Water Samples in ppm for Monitor Well G15D.

Parameters	Dates Samples Collected				
	1-26-83	2-28-83	6-29-83	8-24-83	10-11-83
Arsenic				Dry	Dry
Boron				Dry	Dry
Cadmium				Dry	Dry
Chloride				Dry	Dry
Chromium (total)				Dry	Dry
Copper				Dry	Dry
Fluoride				Dry	Dry
Iron				Dry	Dry
Lead				Dry	Dry
Manganese				Dry	Dry
Nickel				Dry	Dry
Residue on Evaporation				Dry	Dry
Silver				Dry	Dry
Sulfate				Dry	Dry
Zinc				Dry	Dry

Chemical Analysis of Water Samples in ppm for Monitor Well

Parameters	Dates Samples Collected				
	1-26-83	2-28-83	6-29-83	8-24-83	10-11-83
Arsenic	--	--	--	0.000	0.002
Boron	--	--	--	1.1	0.9
Cadmium	--	--	--	0.00	0.02
Chloride	--	--	--	55.0	49.0
Chromium (total)	--	--	--	0.0	0.0
Copper	--	--	--	0.0	0.04
Fluoride	--	--	--	0.4	0.3
Iron	--	--	--	0.0	0.0
Lead	--	--	--	0.0	0.05
Manganese	--	--	--	0.63	0.70
Nickel	--	--	--	0.0	0.0
Residue on Evaporation	--	--	--	964.0	946.0
Silver	--	--	--	0.00	0.00
Sulfate	--	--	--	295.0	355.0
Zinc	--	--	--	0.1	0.0

Chemical Analysis of Water Samples in ppm for Monitor Well G16D.

Parameters	Dates Samples Collected				
	1-26-83	2-28-83	6-29-83	8-24-83	10-11-83
Arsenic	--	--	--	0.005	0.002
Boron	--	--	--	0.5	0.5
Cadmium	--	--	--	0.0	0.0
Chloride	--	--	--	129.0	108.0
Chromium (total)	--	--	--	0.0	0.0
Copper	--	--	--	0.0	0.0
Fluoride	--	--	--	0.8	0.9
Iron	--	--	--	2.5	0.0
Lead	--	--	--	0.0	0.05
Manganese	--	--	--	1.90	1.51
Nickel	--	--	--	0.0	0.0
Residue on Evaporation	--	--	--	1,324.0	1,306.0
Silver	--	--	--	0.00	0.00
Sulfate	--	--	--	570.0	575.0
Zinc	--	--	--	0.0	0.0

Chemical Analysis of Water Samples in ppm for Monitor Well G17S.

Parameters	Dates Samples Collected				
	1-26-83	2-28-83	6-29-83	8-24-83	10-11-83
Arsenic	--	--	--	0.006	0.008
Boron	--	--	--	0.9	0.7
Cadmium	--	--	--	0.0	0.0
Chloride	--	--	--	89.0	89.0
Chromium (total)	--	--	--	0.0	0.0
Copper	--	--	--	0.0	0.0
Fluoride	--	--	--	0.3	0.4
Iron	--	--	--	4.2	4.7
Lead	--	--	--	0.0	0.05
Manganese	--	--	--	0.48	0.38
Nickel	--	--	--	0.1	0.0
Residue on Evaporation	--	--	--	1,228.0	1,229.0
Silver	--	--	--	0.00	0.00
Sulfate	--	--	--	500.0	475.0
Zinc	--	--	--	0.0	0.0

Chemical Analysis of Water Samples in ppm for Monitor Well G17D.

Parameters	Dates Samples Collected				
	1-26-83	2-28-83	6-29-83	8-24-83	10-11-83
Arsenic	--	--	--	0.001	dry
Boron	--	--	--	0.5	dry
Cadmium	--	--	--	0.12	dry
Chloride	--	--	--	520.0	dry
Chromium (total)	--	--	--	0.12	dry
Copper	--	--	--	0.0	dry
Fluoride	--	--	--	0.2	--
Iron	--	--	--	0.1	dry
Lead	--	--	--	0.0	dry
Manganese	--	--	--	1.58	dry
Nickel	--	--	--	0.1	--
Residue on Evaporation	--	--	--	3,508.0	dry
Silver	--	--	--	0.00	--
Sulfate	--	--	--	1,375.0	dry
Zinc	--	--	--	0.2	--

Chemical Analysis of Water Samples in ppm for Monitor Well G18S.

Parameters	Dates Samples Collected				
	1-26-83	2-28-83	6-29-83	8-24-83	10-11-83
Arsenic	--	--	--	0.001	0.002
Boron	--	--	--	0.9	0.0
Cadmium	--	--	--	17.0	13.0
Chloride	--	--	--	1,500.0	530.0
Chromium (total)	--	--	--	0.01	0.0
Copper	--	--	--	0.0	0.0
Fluoride	--	--	--	8.0	9.8
Iron	--	--	--	18.0	6.5
Lead	--	--	--	0.05	0.05
Manganese	--	--	--	80.0	46.0
Nickel	--	--	--	2.5	1.6
Residue on Evaporation	--	--	--	7,142.0	4,506.0
Silver	--	--	--	0.01	0.01
Sulfate	--	--	--	2,950.0	2,300.0
Zinc	--	--	--	100.0	90.0

Chemical Analysis of Water Samples in ppm for Monitor Well G18D.

**Appendix B**  
**Soil Boring Logs**





# Illinois Environmental Protection Agency

BORING NO. B-55		WELL NO. <del>G-1055</del> G155		GROUND LEVEL ELEV. 425.94		PAGE 1 OF 2				
COUNTY Madison		SITE NO. L11904007		DATE START 7/19/83 FINISH 7/19/83		ANNULUS FILL MATERIAL ABOVE PACKING silica sand with bentonite				
SITE Granite City / Taracorp				TIME START 9:15A. FINISH 4:30P.		PACKING Ca bentonite in concrete				
BORING LOCATION NW corner of site along RR tracks						SCREEN silica sand				
DRILLING EQUIPMENT CME 55 3 1/4 inch I.D. hollow stem augers										
COMPLETION DEPTH 26.5 ft.		BEDROCK DEPTH -		TOP OF CASING 428.87 PVC						
WELL CASING 2 inch I.D. flush joint threaded schedule 40 PVC		TYPE AND QUANTITY		SAMPLES				PERSONNEL		
SCREEN INTERVAL 21-26 ft. PVC #10 slot 2 inch I.D. flush joint threaded schd. 40		TYPE AND QUANTITY						L. Sherry Otto D. Doug Tolan H. Ken Bosie		
ELEV. 425.94		DESCRIPTION		DEPTH		REMARKS				
			Dark brown to black <u>sandy Silt</u>		0					drilled to 2.5 ft. with no samples taken; description from cuttings
					1					
					2					
			2.5-2.8 Light brown <u>silty Sand</u> , very fine grained, some roots		3	S <sub>1</sub>	SS	1.0	3/5	
			2.8-3.5 Gray <u>silty Clay</u> with some iron staining, trace roots		4					
			4.0-4.4 Brown <u>silty Clay</u> with trace iron staining		5	S <sub>2</sub>	SS	1.0	4/4	
			4.4-5.0 Light brown <u>silty Sand</u> , very fine to fine grain, trace roots		6	S <sub>3</sub>	SS	0.9	3/2	
			5.5-5.8 Light brown <u>Silt</u>		7					
			5.8-6.3 Light brown <u>Sand</u> very fine to fine grain, trace roots, some iron staining, dry		8	S <sub>4</sub>	SS	1.5	1/1	
			7.0-7.2 Same as above, moist		9	S <sub>5</sub>	SS	1.2	4/7	
			7.2-8.5 Grayish brown <u>Silt</u> , trace roots, little iron staining, blocky, wet		10					
			8.5-9.0 Same as above		11	S <sub>6</sub>	SS	1.5	7/4	
			9.0-9.7 Brown <u>silty Sand</u> , very fine to fine grain, moist		12	S <sub>7</sub>	SS	1.5	5/5	
			9.7-10.0 Gray to brown <u>Sand</u> , fine grain, thinly bedded		13					
			10.0-11.5 Same as above							
			11.5-13.0 Gray to brown <u>Sand</u> fine to medium grain, thinly bedded, moist							



# Illinois Environmental Protection Agency

BORING NO. <u>B-5S</u>		WELL NO. <u>G1055 G15S</u>		GROUNDLEVEL ELEV. <u>412.94</u>		PAGE <u>2</u> OF <u>2</u>			
COUNTY <u>Madison</u>		SITE NO. <u>L11904007</u>		DATE		ANNULUS FILL MATERIAL			
SITING LOCATION <u>Granite City / Taracorp</u>		START		FINISH		ABOVE PACKING			
DRILLING EQUIPMENT		TIME		FINISH		PACKING			
COMPLETION DEPTH		BEDROCK DEPTH		TOP OF CASING		SCREEN			
WELL CASING		TYPE AND QUANTITY		SAMPLES				PERSONNEL	
SCREEN INTERVAL		TYPE AND QUANTITY		L. D. H.				REMARKS	
ELEV.	DESCRIPTION	DEPTH	Sample No.	Sample Type	Sample Recovery Ft.	Penetrometer (S. Weight)	N Value (Blow)		
412.94	13-14.5 Same as above	13	S <sub>8</sub>	SS	1.5		10/16		
	14.5-16 Same as above	14							
410.94	16-17.5 Same as above	15	S <sub>9</sub>	SS	1.5		15/17		
	17.5-19 Same as above	16							
	19-20.5 Same as above	17	S <sub>10</sub>	SS	1.3		17/19		
	20.5-20.7 Same as above	18							
	20.7-21 Gray <u>Clay</u> , hard, moist, iron band at contact with sand at top and bottom	19	S <sub>11</sub>	SS	1.5		19/25		
405.94	21-22 Light brown <u>Sand</u> medium to coarse grain with trace pebbles angular to subangular, moist	20	S <sub>12</sub>	SS	1.5		21/13		
	22-22.7 Same as above	21							
	22.7-23.3 Brown <u>Sand</u> , very coarse grain angular to subangular, wet	22	S <sub>13</sub>	SS	1.5	0.5	9/11	Penetrometer reading taken from 20.7 to 21 ft	
	23.3-26.5 Brown <u>Sand</u> very fine to fine grain, wet	23	S <sub>14</sub>	SS	1.4		7/5	← H <sub>2</sub> O	
400.94		24	S <sub>15</sub>	SS	1.2		8/9	Split spoon Sampled to 26.5 ft Augered to 26 ft	
		25							
		26	S <sub>16</sub>	SS	1.5		10/14		
399.44	Boring complete								



# Illinois Environmental Protection Agency

BORING NO <b>B-5D</b>		WELL NO <b>G105D G15D</b>		GROUNDLEVEL ELEV <b>426.05</b>		PAGE <b>1</b> OF <b>1</b>	
COUNTY <b>Madison</b>		SITE NO <b>L11904007</b>		DATE <b>7/20/83</b> <b>7/20/83</b>		ANNULUS FILL MATERIAL <b>Cuttings</b>	
SITE <b>Granite City/Taracorp</b>				START <b>7/20/83</b>		FINISH <b>7/20/83</b>	
BORING LOCATION <b>NW corner of site along RR tracks</b>				START <b>9:00A.</b>		FINISH <b>7:15P.</b>	
DRILLING EQUIPMENT <b>CME 55 3 1/4 inch I.D. hollow stem auger</b>				START <b>9:00A.</b>		FINISH <b>7:15P.</b>	
COMPLETION DEPTH <b>41.5 ft.</b>		BEDROCK DEPTH <b>—</b>		TOP OF CASING <b>428.99 PVC</b>		PACKING <b>Concrete with Ca ben- tonite</b>	
WELL CASING <b>2 inch I.D. flush joint threaded schedule 40 PVC</b>		TYPE AND QUANTITY <b>—</b>		SCREEN <b>in situ sand</b>		PERSONNEL <b>Sherry Otto Doug Tolan Ken Bosie</b>	
SCREEN INTERVAL <b>30.3 - 35.3 ft. PVC #10 slot 2 inch I.D. flush joint threaded schedule 40</b>		TYPE AND QUANTITY <b>—</b>		SAMPLES		REMARKS	
ELEV <b>426.05</b>		DESCRIPTION		DEPTH		REMARKS	
396.05		<b>Brown Sand medium to very coarse grain, wet</b>		0		<b>Augered from 0-40 ft with no samples taken; description from cuttings</b>	
30							
31							
32							
33							
34							
35							
36							
37							
38							
39							
40		SS					
384.55		<b>Boring complete</b>					



# Illinois Environmental Protection Agency

BORING NO.		WELL NO.		GROUNDLEVEL ELEV.		PAGE		
COUNTY		SITE NO.		DATE		ANNULUS FILL MATERIAL		
B-65		G1065 G165		421.12		1 2		
Madison		L11904007		7/21/83 7/21/83		ABOVE PACKING silica sand with bentonite		
Granite City / Taracorp								
BORING LOCATION		SIZE		TYPE		PACKING		
West side of Taracorp along RR tracks south of B-5		3 1/4 inch I.D. hollow stem auger		CME 55		concrete with Ca bentonite		
COMPLETION DEPTH		BEDROCK DEPTH		TOP OF CASING		SCREEN		
22 ft.		—		424.00 PVC		silica sand		
WELL CASING		TYPE AND QUANTITY		SAMPLES				
2 inch I.D. flush joint threaded schedule 40 PVC								
SCREEN INTERVAL		TYPE AND QUANTITY		PERSONNEL				
15.79 to 20.79 ft. PVC #10 slot 2 inch I.D. flush joint threaded schedule 40				L. Sherry Otto D. Doug Tolan H. Ken Bosie				
ELEV.	DESCRIPTION	DEPTH	Sample No.	Sampler Type	Sample Recovery Ft.	Penetrometer (S length)	N Value (Blow)	REMARKS
421.12	0 - 1.5 <u>Fill material</u>	0						
		1						
	1.5 - 5.0 <u>Brown-gray Sand</u> very fine to fine grained, thinly bedded, iron stains	2	S <sub>1</sub>	CS	2.4			
		3						
		4						
416.12	5.0 - 10.0 <u>Gray silty Clay</u> , iron stains, blocky, brown wet silt seam at 8.6, more brown at bottom	5						
		6	S <sub>2</sub>			0.5		
		7						
		8						
		9	S <sub>3</sub>			1.75		
411.12	10.0 - 10.85 Same as above	10						Penetrometer reading taken from 10 to 10.85 ft.
	10.85 - 11.0 <u>Brown Sand</u> very fine to fine grain, iron stains	11	S <sub>4</sub>	SS	1.5	1.25	3/4	
	11.0 - 11.15 <u>Gray brown silty Clay</u> , iron staining							
	11.15 - 11.5 <u>Gray brown Sand</u> very fine to fine grain					1.0		Penetrometer reading taken from 11.5 to 11.9 ft.
	11.5 - 11.9 <u>Brown gray silty Clay</u>	12	S <sub>5</sub>	SS	1.5		3/2	
	11.9 - 13.0 <u>Brown gray Sand</u> very fine to fine grain, moist	13						



# Illinois Environmental Protection Agency

BORING NO. <b>B-65</b>		WELL NO. <b>G1065 G165</b>		GROUNDLEVEL ELEV.		PAGE <b>2</b> OF <b>2</b>	
COUNTY <b>Madison</b>		SITE NO. <b>L11904007</b>		DATE		ANNULUS FILL MATERIAL	
SITE <b>Granite City / Taracorp</b>				START		FINISH	
BORING LOCATION				TIME		PACKING	
COMPLETION DEPTH		BEDROCK DEPTH		TOP OF CASING		SCREEN	
WELL CASING				PERSONNEL			
SCREEN INTERVAL				SAMPLES			
TYPE AND QUANTITY				L. D. H.			
TYPE AND QUANTITY				REMARKS			
ELEV	DESCRIPTION	DEPTH	Sample No	Sample Type	Sample Recovery (%)	Penetration (lb/inch)	N Value (blows)
408.12	13.0-14.5 Brown <u>Sand</u> very fine to fine grain, iron staining, wet	13	S <sub>6</sub>	SS	1.2		4/3
406.12	14.5-16.0 Light gray <u>Clay</u> little iron staining	14					
		15	S <sub>7</sub>	SS	1.5	1.0	3/3
	16.0-17.5 Same as above; becoming more silty at bottom, sand filled fractures	16	S <sub>8</sub>	SS	1.0		3/3
	17.5-18.9 Brown <u>Sand</u> very fine to fine grain, thinly bedded, trace iron staining, wet	17					
		18	S <sub>9</sub>	SS	1.4		4/6
401.12	19.5-20.5 Gray brown <u>Sand</u> very fine to fine grain, wet	19	S <sub>10</sub>	SS	1.1		6/7
	20.5-22.0 Brown <u>Sand</u> fine to coarse grain subangular to subrounded, poorly sorted, iron staining, wet	20					
		21	S <sub>11</sub>	SS	1.4		5/8
399.12	Boring complete	22					



# Illinois Environmental Protection Agency

BORING NO. <u>B-6D</u>		WELL NO. <u>G106D G16D</u>		GROUNDLEVEL FLEV. <u>421.10</u>		PAGE <u>1</u> OF <u>2</u>		
COUNTY <u>Madison</u>		SITE NO. <u>L11904007</u>		DATE <u>7/25/83</u> <u>7/25/83</u>		ANNULUS FILL MATERIAL <u>silica sand with bentonite</u>		
SITE <u>Granite City/Tarasorp</u>		BORING LOCATION <u>West side of Tarasorp along RR tracks</u>		START TIME <u>8:55A</u> <u>2:00P.</u>		PACKING <u>concrete with Ca bentonite</u>		
DRILLING EQUIPMENT <u>CME 55 3 1/4 inch I.D. hollow stem auger</u>		SIZE <u>423.93 PVC</u>		FINISH		SCREEN <u>in situ sand</u>		
COMPLETION DEPTH <u>35.0 ft.</u>		BEDROCK DEPTH <u>—</u>		TOP OF CASING		PERSONNEL		
WELL CASING <u>2 inch I.D. flush joint threaded schedule 40 PVC</u>		TYPE AND QUANTITY		SAMPLES				
SCREEN INTERVAL <u>29.91 - 34.91 ft. PVC #10 slot 2 inch I.D. flush joint threaded Schd 40</u>		TYPE AND QUANTITY		PERSONNEL				
ELEV.	DESCRIPTION	DEPTH	Sample No.	Sampler Type	Sample Recovery Ft.	Penetration (Strength)	N Value (blows)	REMARKS
421.10		0						
		19						
401.10	19.5 - 20.5 Gray brown Sand very fine to fine grain, wet	20						
	20.5 - 21.0 Brown Sand fine to medium grain, wet	21						
	21.0 - 21.7 Brown Sand very fine to very coarse grain, poorly sorted, sub-angular	22	CS 23					
		23	S <sub>12</sub>					
		24						
396.10	24.5 - 27.0 Same as above	25						
		26	S <sub>13</sub> CS 27					
		27						
	27.0 - 30.0 Same as above	28	S <sub>14</sub> CS 15					
		29						
391.10		30						



# Illinois Environmental Protection Agency

BORING NO. <b>B-6D</b>		WELL NO. <b>G106D G16D</b>		GROUNDLEVEL ELEV.		PAGE <b>2</b> OF <b>2</b>				
COUNTY <b>Madison</b>		SITE NO. <b>L11904007</b>		DATE		FINISH				
SITE <b>Granite City / Taracorp</b>				START		ABOVE PACKING				
BORING LOCATION				TIME		PACKING				
DRILLING EQUIPMENT		SIZE		START		FINISH				
COMPLETION DEPTH		BEDROCK DEPTH		TOP OF CASING		SCREEN				
WELL CASING		TYPE AND QUANTITY		SAMPLES				PERSONNEL		
SCREEN INTERVAL		TYPE AND QUANTITY						L. D. H.		
ELEV	DESCRIPTION			DEPTH	Sample No	Sampler Type	Sample Recovery Ft	Penetrometer (Strength)	N Value (Blow ft)	REMARKS
391.10	30.0 - 33.0 Same as above; becoming very coarse at bottom			30						
				31	S <sub>15</sub>	CS	3.4			
				32						
388.10	33.0 - 35.0 Same as above			33						
				34	S <sub>16</sub>	CS	0.1			
386.10	Boring complete			35						



# Illinois Environmental Protection Agency

BORING NO. B-75		WELL NO. G1075 G17S		GROUNDLEVEL ELEV. 419.06		PAGE 1 OF 2	
COUNTY Madison		SITE NO. L11904007		DATE 7/26/83		FINISH 7/26/83	
SITE Granite City/Taracorp				ABOVE PACKING silica sand and bentonite		SCREEN silica sand	
BORING LOCATION West side of Taracorp along RR tracks				START TIME 10:00A.		FINISH 1:00P.	
DRILLING EQUIPMENT CME 55 3 1/4 inch I.D. hollow stem auger				SCREEN concrete with Ca bentonite		SCREEN silica sand	
COMPLETION DEPTH 22 ft.		BEDROCK DEPTH -		TOP OF CASING 421.07 PVC		WELL CASING 2 inch I.D. flush joint threaded schedule 40 PVC	
SCREEN INTERVAL 17.46-22.46 ft. PVC #10 slot 2 inch I.D. flush joint threaded schedule 40				SAMPLES			
ELEV. 419.06				PERSONNEL L. Sherry Otto, D. Doug Tolan, H. Ken Bosie			
DESCRIPTION				REMARKS			
0 - 2.5 Fill material				Augered to 25ft with no samples taken			
2.5 - 3.5 Same as above							
3.5 - 5.0 Light brown Sand very fine to fine grain, thinly bedded, dry							
5.5 - 6.3 Same as above							
6.3 - 6.6 Light brown Silt							
6.6 - 7.2 Light brown Sand very fine to fine grain, thinly bedded, dry							
7.2 - 8.7 Brown clayey Silt, micaceous, thinly bedded, some roots, iron stains along beds, moist							
8.7 - 10.0 Gray - brown Sand very fine to fine grain, thinly bedded, some roots, iron stains along beds, wet							
10.0 - 10.7 Same as above							
10.7 - 11.1 Brown clayey Silt, iron staining							
11.1 - 11.5 Gray Sand very fine to fine grain, thinly bedded, iron stains along beds, trace roots							
11.5 - 13.0 Gray Sand very fine to fine grain, micaceous, thinly bedded with black streaks along beds, wet							





# Illinois Environmental Protection Agency

BORING NO. <u>B-7S</u>		WELL NO. <u>G1075 G17S</u>		GROUNDLEVEL ELEV. <u>2</u>		PAGE <u>2</u> OF <u>2</u>		
COUNTY <u>Madison</u>		SITE NO. <u>L11904007</u>		DATE		ABOVE PACKING		
BORING LOCATION <u>Granite City/Taracorp</u>				START		FINISH		
DRILLING EQUIPMENT		SIZE		TYPE		PACKING		
COMPLETION DEPTH		BEDROCK DEPTH		TOP OF CASING		SCREEN		
WELL CASING		TYPE AND QUANTITY				PERSONNEL		
SCREEN INTERVAL		TYPE AND QUANTITY						
ELEV.	DESCRIPTION	DEPTH	Sample No	Sampler Type	Sample Recovery Ft	Penetration (lb/inch)	N Value (blows)	REMARKS
406.06	13.0 - 14.5 Same as above	13						
		14		SS	1.2		2/3	
404.06	14.5 - 16.0 Gray <u>Sand</u> very fine to fine grain, thinly bedded, iron stains along beds, roots, wet	15	S <sub>7</sub>	SS	1.4		2/1	
	16.0 - 17.5 Same as above, although more silty	16						
		17	S <sub>8</sub>	SS	1.5		2/2	
	17.5 - 19.0 Gray <u>silty Sand</u> very fine to fine grain, thinly bedded, iron stains, black streaks along beds, wet	18	S <sub>9</sub>	SS	1.5		2/4	
	19.0 - 20.5 Gray <u>Sand</u> very fine to fine grain, thinly bedded, black streaks along beds, iron stains, wet	19						
399.06		20	S <sub>10</sub>	SS	1.3		5/5	
	20.5 - 21.0 Same as above	21						
	21.0 - 22.0 Green gray <u>Sand</u> very fine to fine grain, thinly bedded, black streaks along beds, wet	21	S <sub>11</sub>	SS	1.5		5/6	
397.06	Boring complete	22						



# Illinois Environmental Protection Agency

BORING NO. <b>B-7D</b>		WELL NO. <b>G107D G17D</b>		GROUNDLEVEL ELEV. <b>419.07</b>		PAGE <b>1</b> OF <b>2</b>	
COUNTY <b>Madison</b>		SITE NO. <b>L11904007</b>		DATE <b>7/25/83</b> <b>7/26/83</b>		ABOVE PACKING <b>Silica sand and bentonite</b>	
SITE <b>Granite City / Taracorp</b>				START TIME <b>3:45P.</b> FINISH TIME <b>4:00P.</b>		PACKING <b>Concrete with Ca bentonite</b>	
BORING LOCATION <b>West side of Taracorp along RR tracks</b>						SCREEN <b>in situ sand</b>	
DRILLING EQUIPMENT <b>CME 55 3 1/4 inch I.D. hollow stem auger</b>							
COMPLETION DEPTH <b>35 ft</b>		BEDROCK DEPTH <b>—</b>		TOP OF CASING <b>421.97 PVC</b>			
WELL CASING <b>2 inch I.D. Flush joint threaded schedule 40 PVC</b>		TYPE AND QUANTITY		SAMPLES			
SCREEN INTERVAL <b>30.44 - 35.44 ft. PVC #10 slot 2 inch I.D. Flush joint threaded schd. 40</b>		TYPE AND QUANTITY		PERSONNEL			
ELEV. <b>419.02</b>		DESCRIPTION		REMARKS			
DEPTH							
399.02		20.0-25.0 Gray Sand very fine to fine grain; thinly bedded with black streaks along beds, micaceous, some roots, wet		Augered to 20ft. with no samples taken			
394.02		25.0-30.0 Same as above					
389.02		30.0-31.7 Gray silty Sand very fine to fine grain; black streaks along beds, wet					
		31.7-33.8 Gray Silt black streaks along beds, wet					



# Illinois Environmental Protection Agency

BORING NO. <u>B-7D</u>		WELL NO. <u>G107D G17D</u>		GROUNDLEVEL ELEV.		PAGE <u>2</u> OF <u>2</u>			
COUNTY <u>Madison</u>		SITE NO. <u>L11904007</u>		DATE		ANNUOUS FILL MATERIAL			
SITE <u>Granite City / Taracorp</u>				START		FINISH			
BORING LOCATION				TIME		PACKING			
DRILLING EQUIPMENT		SIZE		START		FINISH			
COMPLETION DEPTH		BEDROCK DEPTH		TOP OF CASING		SCREEN			
WELL CASING		TYPE AND QUANTITY		SAMPLES				PERSONNEL	
SCREEN INTERVAL		TYPE AND QUANTITY		L. O. H.				REMARKS	
ELEV. <u>386.02</u>		DESCRIPTION		DEPTH					
<u>384.02</u>		33.8 - 34.2 Gray <u>sandy Silt</u> black streaks a- long beds, wet.		33					
		34.2 - 35.0 Gray <u>Sand</u> very fine to fine grain, wet.		34		CS			
		Boring complete		35		S <sub>14</sub>			



# Illinois Environmental Protection Agency

BORING NO. <u>B-85</u>		WELL NO. <u>G1085 G185</u>		GROUND LEVEL ELEV. <u>419.94</u>		PAGE <u>1</u> OF <u>2</u>	
COUNTY <u>Madison</u>		SITE NO. <u>L11904007</u>		DATE <u>7/27/83</u>		ABOVE PACKING <u>silica sand and bentonite</u>	
SITE <u>Granite City / Taracorp</u>		START <u>7/27/83</u>		FINISH <u>7/27/83</u>		PACKING <u>concrete with Ca bentonite</u>	
BORING LOCATION <u>West of pile near propane tanks</u>		START <u>7:00A.</u>		FINISH <u>3:00P.</u>		SCREEN <u>in situ sand</u>	
DRILLING EQUIPMENT <u>CME 55 3 1/4 inch I.D. hollow stem auger</u>		TYPE <u>422.88 PVC</u>					
COMPLETION DEPTH <u>22 ft</u>		BEDROCK DEPTH <u>—</u>		TOP OF CASING <u>422.88 PVC</u>			
WELL CASING <u>2 inch I.D. flush joint threaded schedule 40 PVC</u>		TYPE AND QUANTITY <u>15.4-20.4 ft. PVC #10 slot 2 inch I.D. flush joint threaded schd. 40</u>					
SCREEN INTERVAL <u>15.4-20.4 ft. PVC #10 slot 2 inch I.D. flush joint threaded schd. 40</u>		TYPE AND QUANTITY <u>15.4-20.4 ft. PVC #10 slot 2 inch I.D. flush joint threaded schd. 40</u>					
ELEV.	DESCRIPTION	DEPTH	Sample No.	Sample Type	Sample Recovery (%)	Penetrometer (Strength)	N Value (Blow)
419.94	0.0-2.5 Fill material	0					
		1					
		2					
	2.5-5.0 Same as above	3					
		4	S <sub>1</sub>	CS			
		5					
414.94	5.0-6.4 Same as above, wet	6	S <sub>2</sub>				
		7					
	6.4-8.4 Light brown <u>Sand</u> very fine to fine grain, wet	8	S <sub>3</sub>				
		9					
		10	S <sub>4</sub>	SS	1.5		5/6
	10.8-11.5 Dark gray - green <u>Clay</u> mottled, moist	11	S <sub>5</sub>		1.5		
	11.5-12.5 Same as above	12	S <sub>6</sub>	SS	1.2		4/5
409.94	12.5-12.7 Brown <u>clayey Sand</u> iron stains, fine grain, moist	13					

L. Sherry Otto  
D. Doug Tolan  
H. Ken Bosie

REMARKS

Augered to 2.5 ft. with no samples taken



# Illinois Environmental Protection Agency

BORING NO.		WELL NO.		GROUNDLEVEL ELEV.		PAGE		
COUNTY		SITE NO.		DATE		ANNUALS FILL MATERIAL		
SITING		TIME		FINISH		PACKING		
COMPLETION DEPTH		BEDROCK DEPTH		TOP OF CASING		SCREEN		
WELL CASING		TYPE AND QUANTITY		SAMPLES		PERSONNEL		
SCREEN INTERVAL		TYPE AND QUANTITY		REMARKS				
ELEV	DESCRIPTION	DEPTH	Sample No	Sample Type	Sample Recovery Ft	Penetration (lb/ft)	N Value (blows)	REMARKS
406.94	13.0-14.5 Brown Sand very fine to fine grain, thinly bedded, iron stains along bedding, moist	13	S <sub>7</sub>	SS	1.1		10/14	
404.94	14.5-16.0 Same as above	14	S <sub>8</sub>	SS	0.9		6/5	
	16.0-17.5 Same as above, wet at bottom	16	S <sub>9</sub>	SS			4/3	← H <sub>2</sub> O
	17.5-19.0 Same as above	18	S <sub>10</sub>	SS			11/14	
	19.0-20.5 Same as above, although no iron stains	19	S <sub>11</sub>	SS			12/12	Pulled auger up to 20.0ft. and installed well.
399.94	20.5-22.0 Brown Sand fine grain, some black streaks at bottom along bedding, wet	21	S <sub>12</sub>	SS			7/11	
397.94	Boring complete	22						



# Illinois Environmental Protection Agency

BORING NO. <b>B-8D</b>		WELL NO. <b>G1000 G18D</b>		GROUNDLEVEL ELEV. <b>420.00</b>		PAGE <b>1</b> OF <b>2</b>		
COUNTY <b>Madison</b>		SITE NO. <b>L11904007</b>		DATE		ANNULUS FILL MATERIAL		
SITE <b>Granite City/Taracorp</b>		START <b>7/28/83</b>		FINISH <b>7/28/83</b>		ABOVE PACKING <b>silica sand and bentonite</b>		
BORING LOCATION <b>West of pile near propane tanks</b>		TIME		FINISH		PACKING <b>concrete with Ca bentonite</b>		
DRILLING EQUIPMENT <b>CME 55 3 1/4 inch I.D. hollow stem auger</b>		START <b>7:00A.</b>		FINISH <b>11:30A.</b>		SCREEN <b>in situ sand</b>		
COMPLETION DEPTH <b>35 ft.</b>		BEDROCK DEPTH <b>-</b>		TOP OF CASING <b>421.88 PVC</b>		PERSONNEL		
WELL CASING <b>2 inch I.D. flush joint threaded schedule 40 PVC</b>		TYPE AND QUANTITY		SAMPLES				
SCREEN INTERVAL <b>27.26 - 32.26 ft. PVC #10 slot 2 inch I.D. flush joint threaded schedule 40</b>		TYPE AND QUANTITY		PERSONNEL				
ELEV.	DESCRIPTION	DEPTH	Sample No.	Sample Type	Sample Recovery (%)	Penetration Resistance (Strength)	N Value (blows)	REMARKS
420.0		0						
		↓						
4000	20.0-25.0 Brown <u>Sand</u> fine grain, wet	20						Augered to 20 ft with no samples taken
		21						
		22		CS				
		23						
		24	S <sub>13</sub>					
3950	25.0-30.0 Same as above, gray at bottom	25						
		26	S <sub>14</sub>					
		27						
		28		CS				
		29	S <sub>15</sub>					
3900	30.0-35.0 Gray <u>Sand</u> fine to medium grain, micaceous, brown staining from 34 to 35 ft., black streaks along beds through bottom 2 inches, wet	30						
		31	S <sub>16</sub>					
		32						
		33		CS				
			S <sub>17</sub>					



# Illinois Environmental Protection Agency

BORING NO. <b>B-8D</b>		WELL NO. <b>G1000 G18D</b>		GROUNDLEVEL ELEV. <b>420.0</b>		PAGE <b>2</b> OF <b>2</b>	
COUNTY <b>Madison</b>		SITE NO. <b>L11904007</b>		DATE		ANNULUS FILL MATERIAL	
SITE <b>Granite City / Taracorp</b>				START		FINISH	
BORING LOCATION				TIME		PACKING	
DRILLING EQUIPMENT		SIZE		TYPE		SCREEN	
COMPLETION DEPTH		BEDROCK DEPTH		TOP OF CASING			
WELL CASING		TYPE AND QUANTITY		SAMPLES			
SCREEN INTERVAL		TYPE AND QUANTITY		PERSONNEL			
ELEV.	DESCRIPTION	DEPTH	Sample No.	Sampler Type	Sample Recovery %	Penetration (lb/inch)	N Value (blows)
<b>387.0</b>		<b>33</b>					
	<b>30.0-35.0 Gray Sand fine to medium grain, micaceous, brown staining from 34 to 35 ft.; black streaks along beds through bottom 2 inches, wet</b>	<b>34</b>	<b>S17</b>				
<b>385.0</b>		<b>35</b>					
	<b>Boring complete</b>						

Appendix C  
Monitor Well Construction Data



# MONITOR WELL CONSTRUCTION

Well No. G 155  
~~G 105S~~  
 Prepared by: S. Otto

Elev.

428.87 (Top of PVC)

Stick-up 2.93

Depth

425.94 ---Ground Surface---

Concrete with bentonite plug

423.94

2 ft.

*Southern  
Ca Bentonite  
used*

Packed with silica  
sand and bentonite

412.14

Concrete with bentonite seal

13.8 ft.

406.94

19.0 ft.

404.94

21.0 ft.

Screen

Total length 5 ft.

Packed with silica  
sand from 19-23 ft  
in situ sand 23-26

399.94

26.0 ft.

399.94

Bottom of boring

26.0 ft.

Pipe: Type and quantity 2 inch I.D flush joint threaded schedule 40 PVC with  
#10 slot screen; total feet of casing including screen is 28.93 ft.; used  
teflon tape on threaded joints; a 5 ft. x 4 inch diameter steel pro-  
tective cover was installed with padlock.

Well No. G 15D  
Prepared by: S. Otto

428.99 (Top of PVC)

Depth

426.05

0

423.05

3 ft

Southern  
Ca Bentonite  
used

Packed with

cuttings

406.05

20 ft.

403.75

22.3 ft.

395.75

30.3 ft

Screen

Total length 5ft.

Packed with

in situ sand

390.75

35.3 ft.

390.75 Bottom of boring.

35.3 ft

Pipe: Type and quantity 2 inch I.D flush joint threaded schedule 40 PVC with #10 slot screen; total feet of casing including screen is 38.19 ft; used teflon tape on threaded joints; a 5 ft x 4 inch diameter steel protective cover was installed with padlock.

# MONITOR WELL CONSTRUCTION

G16S

Well No. G106S

Prepared by: S. Otto

Elev.

424.00 (top of PVC)

Stick up 2.88ft.

Depth

421.12

---Ground Surface---

0

Concrete with bentonite plug

417.12

4 ft.

*Southern  
Ca Bentonite  
used*

Packed with silica  
sand and bentonite

412.62

8.5 ft

Concrete with bentonite seal

408.12

13 ft.

405.33

15.79 ft.

Screen

Total length 5 ft.

Packed with silica  
sand 13 to 18.2 ft

400.33

20.79 ft.

400.62

---Bottom of boring---

20.5 ft.

Pipe: Type and quantity 2 inch I.D. flush joint threaded schedule 40 PVC with  
#10 (0.01 inch) slot screen; total feet of casing including screen is  
23.67 ft.; used teflon tape on threaded joints; a 5 ft. x 4 inch di-  
ameter steel protective cover was installed with padlock.

# MONITOR WELL CONSTRUCTION

G16D

Well No. ~~G106D~~

Prepared by: S. Otto

Elev.

423.93 (top of PVC)

stick up 2.83 ft.

Depth

421.10 Ground Surface

Concrete with bentonite plug

416.10

5 ft.

Southern  
Ca Bentonite  
used

Packed with silica  
sand and bentonite

406.10

Concrete with bentonite seal

15 ft.

402.10

19 ft.

391.19

29.9 ft.

Screen

Total length 5 ft.

Packed with in

situ sand

386.19

34.9 ft.

386.10

Bottom of boring

35 ft.

Pipe: Type and quantity 2 inch I.D. flush joint threaded schedule 40 PVC with #10 (0.01 inch) slot screen; total feet of casing including screen 37.74 ft.; used teflon tape on threaded joints; a 5 ft. x 4 inch diameter steel protective cover was installed with pad lock.

# MONITOR WELL CONSTRUCTION

G175  
Well No. ~~G1075~~

Prepared by: S. Otto

Elev.

421.07 (top of PVC)

Depth

419.06 ---Ground Surface---

0

Concrete with bentonite plug

415.06

4 ft.

*Southern  
Ca Bentonite  
used*

Packed with silica  
sand and bentonite

408.06

11 ft.

Concrete with bentonite seal

403.56

15.5 ft.

401.60

17.46 ft.

Screen

Total length 5 ft.

Packed with silica  
sand 15.5 to 17 ft.;  
in situ sand 17 to 22 ft.

396.60

22.46 ft.

397.06

Bottom of boring

22 ft.

Pipe: Type and quantity 2 inch I.D. flush joint threaded schedule 40 PVC with #10 (0.01 inch) slot screen; total feet of casing including screen is 24.47 ft.; used teflon tape on threaded joints; a 5 ft. x 4 inch diameter steel protective cover was installed with padlock.

# MONITOR WELL CONSTRUCTION

G 17 D  
Well No. ~~G 107 D~~

Prepared by: S. Otto

Elev.

421.97 (top of PVC)

stick up 2.90 ft.

Depth

419.07 Ground Surface

0

Concrete with bentonite plug

415.07

4 ft.

Southern  
Ca Bentonite  
used

Packed with silica  
sand and bentonite

402.07

17 ft.

Concrete with bentonite seal

400.07

19 ft.

388.63

30.44 ft.

Screen

Total length 5 ft.

Packed with in situ  
sand

383.63

35.44 ft.

384.07 Bottom of boring

35 ft.

Pipe: Type and quantity 2 inch I.D. flush joint threaded schedule 40 PVC with #10 (0.01 inch) slot screen; total feet of casing including screen is 38.34 ft.; used teflon tape on threaded joints; a 5 ft. x 4 inch diameter steel protective cover was installed with padlock.

# MONITOR WELL CONSTRUCTION

G185  
Well No. ~~G1085~~  
Prepared by: S. Otto

Elev.

422.88 (Top of PVC)

stick up 2.94 ft.

Depth

419.34 Ground Surface

Concrete with bentonite plug

416.34

3 ft.

Southern  
Ca Bentonite  
used

Packed with silica  
sand and bentonite

412.54

Concrete with bentonite seal

6.8 ft.

411.94

7.4 ft.

404.54

15.4 ft.

Screen

Total length 5 ft.

Packed with

in situ sand

399.54

20.4 ft.

398.84

Bottom of boring

20.5 ft.

Pipe: Type and quantity 2 inch I.D. flush joint threaded schedule 40 PVC with  
#10 (0.01 inch) screen; total feet of casing including screen 23.34 ft.; used  
teflon tape on threaded joints; a 5 ft. x 4 inch diameter steel protective  
cover was installed with padlock.

# MONITOR WELL CONSTRUCTION

G 18D

Well No. ~~G 108D~~

Prepared by: S. Otto

Elev.

---421.88 (top of PVC)---

stick up 1.88 ft.

Depth

---420.00---Ground Surface

0

Concrete with bentonite plug

---417.00---

3 ft.

*Southern  
Ca Bentonite  
used*

Packed with silica  
sand and bentonite

---414.00---

6 ft.

Concrete with bentonite seal

---412.00---

8 ft.

---392.74---

27.26 ft.

Screen

Packed with

Total length 5 ft.

in situ sand

---387.74---

32.26 ft.

---385.00---Bottom of boring---

35 ft.

Pipe: Type and quantity 2 inch I.D. flush joint threaded schedule 40 PVC with #10 (0.01 inch) screen; total feet of casing including screen 34.14 ft; used teflon tape on threaded joints; a 5 ft x 4 inch diameter steel protective cover was installed with padlock.